KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, AUG. 10, 1883.

CONTENTS OF No. 93.

	PAGE
Vesuvius and Ischia. By R. A. Proctor	81
The Birth and Growth of Myth. XIII. By Edward Clodd	83
Pretty Proofs of the Earth's Rotundity. (*Illus.*) By R A. Proctor	84
The Moon in a Three-Inch Telescope (*Illus.*) By F.R.A.S.	86
Weather Forecasts, and How to Make Them. By John Browning	87
The Fisheries Exhibition. IV. (*Illus.*) By John Ernest Ady	87
Sea Anemones: The White Carnation. (*Illus.*) By T. Kimber	89
A Steamer goes Safely Past Niagara Whirlpool	90
Principles of Dress Reform. By E. M. King	91
Chemistry of the Cereals. III. By William Jago, F.C.S.	93
Editorial Gossip	94
Correspondence	94
Our Mathematical Column	95
Our Chess Column	96

VESUVIUS AND ISCHIA.

By RICHARD A. PROCTOR.

THE following passages from an essay on Vesuvius, in my "Light Science for Leisure Hours," may prove of interest just now, when Vesuvius and Ischia have shown the close connection which exists between them.

"In the volcanic region of which Vesuvius or Somma is the principal vent, we have a remarkable instance of the deceptive nature of that state of rest into which some of the principal volcanoes frequently fall for many centuries together. For how many centuries before the Christian era Vesuvius had been at rest is not known; but this is certain, that from the landing of the first Greek colony in Southern Italy, Vesuvius gave no signs of internal activity. It was recognised by Strabo as a volcanic mountain, but Pliny did not include it in the list of active volcanoes. In those days, the mountain presented a very different appearance from that which it now exhibits. In place of the two peaks now seen, there was a single, somewhat flattish summit, on which a slight depression marked the place of an ancient crater. The fertile slopes of the mountain were covered with well-cultivated fields, and the thriving cities Herculaneum, Pompeii, and Stabiæ stood near the base of the sleeping mountain. So little did any thought of danger suggest itself in those times, that the bands of slaves, murderers, and pirates which flocked to the standards of Spartacus found a refuge, to the number of many thousands, within the very crater itself.

"But though Vesuvius was at rest, the region of which Vesuvius is the main vent was far from being so. The island of Pithecusa (the modern Ischia) was shaken by frequent and terrible convulsions. It is even related that Prochyta (the modern Procida) was rent from Pithecusa in the course of a tremendous upheaval, though Pliny derives the name of Prochyta (or "poured forth") from the supposed fact of this island having been poured forth by an eruption from Ischia. Far more probably, Prochyta was formed independently by submarine eruptions, as the volcanic islands near Santorin have been produced in more recent times.

"So fierce were the eruptions from Pithecusa, that several Greek colonies which attempted to settle on this island were compelled to leave it. About 380 years before the Christian era, colonists under King Hiero of Syracuse, who had built a fortress on Pithecusa, were driven away by an eruption. Nor were eruptions the sole cause of danger. Poisonous vapours, such as are emitted by volcanic craters after eruption, appear to have exhaled, at times, from extensive tracts on Pithecusa, and thus to have rendered the island uninhabitable.

"Still nearer to Vesuvius lay the celebrated Lake Avernus. The name Avernus is said to be a corruption of the Greek word *Aornos*, signifying 'without birds,' the poisonous exhalations from the waters of the lake destroying all birds which attempted to fly over its surface. Doubt has been thrown on the destructive properties assigned by the ancients to the vapours ascending from Avernus. The lake is now a healthy and agreeable neighbourhood, frequented, says Humboldt, by many kinds of birds, which suffer no injury whatever even when they skim the very surface of the water. Yet there can be little doubt that Avernus hides the outlet of an extinct volcano; and long after this volcano had become inactive, the lake which concealed its site 'may have deserved the appellation of "atri janua Ditis," emitting, perhaps, gases as destructive of animal life as those suffocating vapours given out by Lake Quilotoa, in Quito, in 1797, by which whole herds of cattle were killed on its shores, or as those deleterious emanations which annihilated all the cattle in the island of Lancerote, one of the Canaries, in 1730.'

"While Ischia was in full activity, not only was Vesuvius quiescent, but even Etna seemed to be gradually expiring, so that Seneca ranks this volcano among the number of nearly extinguished craters. At a later epoch, Ælian asserted that the mountain itself was sinking, so that seamen lost sight of the summit at a less distance across the seas than of old. Yet within the last two hundred years there have been eruptions from Etna rivalling, if not surpassing, in intensity the convulsions recorded by ancient historians.

"I shall not here attempt to show that Vesuvius and Etna belong to the same volcanic system, though there is reason not only for supposing this to be the case, but for the belief that all the subterranean regions whose effects have been shown from time to time over the district extending from the Canaries and Azores, across the whole of the Mediterranean, and into Syria itself, belong to but one great centre of internal action. But it is quite certain that Ischia and Vesuvius are outlets from a single source.

"While Vesuvius was dormant, resigning for awhile its pretensions to be the principal vent of the great Neapolitan volcanic system, Ischia, we have seen, was rent by frequent convulsions. But the time was approaching when Vesuvius was to resume its natural functions, and with all the more energy that they had been for awhile suspended.

"In the year 63 (after Christ) there occurred a violent convulsion of the earth around Vesuvius, during which much injury was done to neighbouring cities, and many lives were lost. From this period shocks of earthquake were felt from time to time for sixteen years. These grew gradually more and more violent, until it began to be evident that the volcanic fires were about to return to their main vent. The obstruction which had so long impeded the exit of the confined matter was not, however, readily removed, and it was only in August of the year 79, after numerous and violent internal throes, that the superincumbent mass was at length hurled forth. Rocks and cinders, lava, sand, and scoriæ,

XUM

were propelled from the crater, and spread many miles on every side of Vesuvius.

"In this great eruption, Vesuvius poured forth lapilli, sand, cinders, and fragments of old lava, but no new lava flowed from the crater. Nor does it appear that any lava-stream was ejected during the six eruptions which took place during the following ten centuries. In the year 1036, for the first time, Vesuvius was observed to pour forth a stream of molten lava. Thirteen years later, another eruption took place; then ninety years passed without disturbance, and after that a long pause of 168 years. During this interval, however, the volcanic system, of which Vesuvius is the main but not the only vent, had been disturbed twice. For it is related that in 1198 the Solfatara Lake crater was in eruption; and in 1302 Ischia, dormant for at least 1,400 years, showed signs of new activity. For more than a year earthquakes had convulsed this island from time to time, and at length the disturbed region was relieved by the outburst of a lava stream from a new vent on the south-east of Ischia. The lava stream flowed right down to the sea, a distance of two miles. For two months, this dreadful outburst continued to rage; many houses were destroyed; and although the inhabitants of Ischia were not completely expelled, as happened of old with the Greek colonists, yet a partial emigration took place.

"The next eruption of Vesuvius occurred in 1306; and then three centuries and a quarter passed during which only one eruption, and that an unimportant one (in 1500), took place. 'It was remarked,' says Sir Charles Lyell, 'that throughout this long interval of rest, Etna was in a state of unusual activity, so as to lend countenance to the idea that the great Sicilian volcano may sometimes serve as a channel of discharge to elastic fluids and lava that would otherwise rise to the vents in Campania.'

"Nor was the abnormal activity of Etna the only sign that the quiescence of Vesuvius was not to be looked upon as any evidence of declining energy in the volcanic system. In 1538 a new mountain was suddenly thrown up in the Phlegræan Fields—a district including within its bounds Pozzuoli, Lake Avernus, and the Solfatara. The new mountain was thrown up near the shores of the Bay of Baiæ. It is 440 feet above the level of the bay, and its base is about a mile and a half in circumference. The depth of the crater is 421 feet, so that its bottom is only six yards above the level of the bay. The spot on which the mountain was thrown up was formerly occupied by the Lucrine Lake; but the outburst filled up the greater part of the lake, leaving only a small and shallow pool.

"The accounts which have reached us of the formation of this new mountain are not without interest. Falconi, who wrote in 1538, mentions that several earthquakes took place during the two years preceding the outburst, and above twenty shocks on the day and night before the eruption. 'The eruption began on September 29, 1538. It was on a Sunday, about one o'clock in the night, when flames of fire were seen between the hot-baths and Tripergola. In a short time the fire increased to such a degree that it burst open the earth in this place, and threw up a quantity of ashes and pumice-stones, mixed with water, which covered the whole country. The next morning the poor inhabitants of Pozzuoli quitted their habitations in terror, covered with the muddy and black shower, which continued the whole day in that country—flying from death, but with death painted in their countenances. Some with their children in their arms, some with sacks full of their goods; others leading an ass, loaded with their frightened family, towards Naples. . . . The sea had retired] on the side of Baiæ, abandoning a considerable tract; and the shore appeared almost entirely dry, from the quantity of ashes and broken pumice-stones thrown up by the eruption.'

"And now, for nearly a century, the whole district continued in repose. Nearly five centuries had passed since there had been any violent eruption of Vesuvius itself; and the crater seemed gradually assuming the condition of an extinct volcano. The interior of the crater is described by Bracini, who visited Vesuvius shortly before the eruption of 1631, in terms that would have fairly represented its condition before the eruption of 79:—'The crater was five miles in circumference, and about a thousand paces deep; its sides were covered with brushwood, and at the bottom there was a plain on which cattle grazed. In the woody parts, wild boars frequently harboured. In one part of the plain, covered with ashes, were three small pools, one filled with hot and bitter water, another salter than the sea, and a third hot, but tasteless.' But in December, 1631, the mountain blew away the covering of rock and cinders which supported these woods and pastures. Seven streams of lava poured from the crater, causing a fearful destruction of life and property. Resina, built over the site of Herculaneum, was entirely consumed by a raging lava-stream. Heavy showers of rain, generated by the steam evolved during the eruption, caused in their turn an amount of destruction scarcely less important than that resulting from the lava-streams; for, falling upon the cone and sweeping thence large masses of ashes and volcanic dust, these showers produced destructive streams of mud, consistent enough to merit the name of 'aqueous lava' commonly assigned to it.

"An interval of thirty-five years passed before the next eruption, but since 1666 there has been a continual series of eruptions, so that the mountain has scarcely ever been at rest for more than ten years together. Occasionally there have been two eruptions within a few months; and it is well worthy of remark that during the three centuries which have elapsed since the formation of Monte Nuovo there has been no volcanic disturbance in any part of the Neapolitan volcanic district save in Vesuvius alone. Of old, as Brieslak well remarks, there had been irregular disturbances in some part of the Bay of Naples once in every two hundred years—the eruption of Solfatara in the twelfth century, that of Ischia in the fourteenth, and that of Monte Nuovo in the sixteenth; but 'the eighteenth has formed an exception to the rule.' It seems clear that the constant series of eruptions from Vesuvius during the past two hundred years has sufficed to relieve the volcanic district of which Vesuvius is the principal vent."

So I wrote a few years ago, but the great earthquake from Ischia shows that the old state of things has not so completely passed away as had been supposed.

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XIII.

TRADITIONS of transformation of men into beasts are not confined to the Old World. In Dr. Rink's "Tales of the Eskimo" there are numerous stories both of men and women who have assumed animal form at will, as also incidental references to the belief in stories such as that telling how an Eskimo got inside a walrus skin, so that he might lead the life of that creature. And among the Red Races, that rough analogy which led to the animal being credited with life and consciousness akin to the human, still expresses

itself in thought and act. If even now it is matter of popular belief in the wilds of Norway that Finns and Lapps, who from remote times have passed as skilful witches and wizards, can at pleasure assume the shape of bears, the common saying, according to Dr. Dasent, about an unusually daring and savage beast being, "that can be no Christian bear," we may not be surprised that lower races still ascribe power of interchange to man and brute. The werewolf superstition is extant among the North-Western Indians, but free from those diabolical features which characterised it in mediæval times among ourselves. It takes its place in barbaric myth generally, and although it may have repellant or cruel elements, it was never blended with belief in the demoniacal. The Ahts say that men go into the mountains to seek their manitou (that is, the personal deity, generally the first animal seen by the native in the dream produced by his fasting on reaching manhood), and, mixing with wolves, are after a time changed into these creatures. Although the illustration bears more upon what has to be said concerning the barbaric belief in animal-ancestors, it has some reference to the matter in hand to cite the custom among the Tonkanays, a wild and unruly tribe in Texas, of celebrating their origin by a grand annual dance. One of them, naked as he was born, is buried in the earth, then the others, clothed in wolf-skins, walk over him, sniff around him, howl in wolfish style, and then dig him up with their nails. The leading wolf solemnly places a bow and arrow in his hands, and, to his inquiry as to what he must do for a living, advises him "to do as the wolves do—rob, kill, and rove from place to place, never cultivating the soil." Dr. Brinton, in quoting the above from Schoolcraft, refers to a similar custom among the ancient dwellers on Mount Soracte.

As in past times among ourselves, so in times present among races such as the foregoing, their wizards and shamans are believed to have power to turn themselves as they choose into beasts, birds, or reptiles. By whatever name these professional impostors are known, whether as medicine-men, or, as in Cherokee, by the high-sounding title of "possessors of the divine fire," they have traded, and wherever credulity or darkest ignorance abide, still trade, on the fears and fancies of their fellows by disguising themselves in voice and gait and covering as the animal which they pretend to be. Among races believing in transformation such tricks have free course, and the more dexterous the sorcerer who could play bear's antics in a bear's skin proved himself in throwing off the disguise and appearing suddenly as a man, the greater his success, and he more firmly grounded the belief.

The whole subject, although presented here only in the barest outline, would not be fitly dismissed without some reference to the survival of the primitive belief in men-animals in the world-wide stories known as Beast-fables, in which animals act and talk like human beings. When to us all Nature was wonderland, and among our play-fellows were the four-footed, the birds, and the fishes; when in fireside tale and rhyme they spoke our language and lived that free life which we then shared and can never share again, the feeling of kinship to which the old fables gave expression may have checked many a wanton act, and, if we learned it not fully then, at least have taken the lesson to heart since,

> Never to blend our pleasure or our pride
> With sorrow of the meanest thing that lives.

And then those "Fables" of Æsop, even with the tedious drawback of the "moral," as powder beneath the jam, did they not lighten for us in school-days the dark passages through our Valpy (for the omniscient Dr. William Smith was not then the tyro's dread), and again give us communion with the fowl of the air and the beast of the field? Now, our mature thought may interest itself in following the beast-myths to the source whence Babrius and Phædrus, knowing not its springhead and antiquity, drew their vivid presentments of the living world, and find in the storied East the wellspring that fed the imagination of youngsters thousands of years ago. With some authorities the Egyptians have the credit of first inventing the beast-fable, but among them, as among every other advanced race, such stories are the remains of an earlier deposit; relics of a primitive philosophy, in which wisdom, and skill, and cunning are no monopoly of man's. The fondness of the negro races, whose traditions are not limited to South and Central Africa, for such fables is well known, as witness the tales of which "Uncle Remus" is a type, and it is strikingly illustrated in the history of the Vai tribe, who having, partly through contact with whites, elaborated a system of writing, made the beast-fable their earliest essay in composition.*

In former papers, the evidence in support of the common ancestry of the languages spoken by the leading peoples in Europe, and by such important historical races in Asia as the Hindu and the Persian, has been summarised. That evidence is likewise conclusive, not only as to the origin of the myths on which the great Indo-European epics are founded, but also as to the possession by the several clans of a common stock of folk-lore and folk-tale, in which, of course, the beast-fable is included, these being the relics in didactic or humorous guise of that serious philosophy concerning the life of man and beast amongst the barbaric ancestors of the Indo-Europeans, upon which stress enough has been laid.

Even if the common origin could be disproved, the evidence would merely be shifted from local to general foundations, because the uniform attitude of mind before the same phenomena would be proven; but the resemblances are too minute in detail to be explained by a theory of independent creation of the tales where now we find them. The likenesses are many; the unlikenesses are few, being the result of local colouring, historical fact blended with the fiction, popular belief, and superstition, all affected by the skill of the professional story-teller. As in the numerous variants of the familiar Cinderella, Beauty and the Beast, Punchkin, and the like, the same fairy prince or princess, the same wicked magician and clever, versatile Boots peep through, disclosing the near relationship of Hindu nursery tales to the folk-tales of Norway and the Highlands, of Iceland and Ceylon, of Persia and Serbia, of Russia and the lands washed by the Mediterranean. In the venerable collection of "Buddhist Birth Stories," now in course of translation by Dr. Rhys Davids,† and to which he has prefaced an interesting introduction on the source and migration of folk-tales, we are face to face with many a fable familiar to us in the "Æsop" of our school-days. There is the story of the Ass in the Lion's Skin, not in which, as Æsop has it, the beast dressed himself, but which the hawker put on him to frighten the thieves who would steal his goods. Left one day to browse in a field whilst his master refreshed himself at an inn, some watchmen saw him, and, raising hue and cry, brought out the villagers, armed with their rude implements. The ass, fearing death,

* Cf. Mahaffy's "Prolegomena to Ancient History," p. 392.

† Vol. I. Trübner & Co. See also, for some valuable illustrations from early English and other sources, an article by Rev. Dr. Morris, in "Contemp. Rev.," May, 1881.

made a noise like an ass, and was killed. Long might he, adds the ancient moral,

> Clad in a lion's skin
> Have fed on the barley green;
> But he brayed!
> And that moment he came to ruin.

The variants of this old fable are found in mediæval, in French, German, Indian, and Turkish folk-lore, as are also those of the tortoise who lost his life through "much speaking." Desiring to emigrate, two ducks agreed to carry him, he seizing hold of a stick which they held between their beaks. As they passed over a village, the people shouted and jeered, whereupon the irate tortoise retorted, "What business is it of yours?" and, of course, thereby let go the stick and, falling down, split in two. Therefore

> Speak wise words not out of season;
> You see how, by talking overmuch,
> The tortoise fell."

In Æsop, the tortoise asks an eagle to teach him to fly; in Chinese folk-lore he is carried by geese.

Jacob Grimm's researches concerning the famous mediæval fable of "Reynard the Fox," revealed the ancient and scattered materials out of which that wonderful satire was woven, and there is no feature of the story which reappears more often in Eastern and Western folk-lore than that cunning of the animal which has been for the lampooner and the satirist the type of self-seeking monk and ecclesiastic. When Chanticleer proudly takes an airing with his family, he meets master Reynard, who tells him he has become a "religious," and shows him his beads, and his missal, and his hair shirt, adding in a voice "that was childlike and bland," that he had vowed never to eat flesh. Then he went off singing his Credo, and slunk behind a hawthorn. Chanticleer, thus thrown off his guard, continues his airing, and the astute hypocrite, darting from his ambush, seizes the plump hen Coppel. So in Indian folk-tale, a wolf living near the Ganges is cut off from food by the surrounding water. He decides to keep holy day, and the god Sakka, knowing his lupine weakness, resolves to have some fun with him, and turns himself into a wild goat. "Aha!" says the wolf, "I'll keep the fast another day," and springing up he tried to seize the goat, who skipped about so that he couldn't be taken. So Lupus gives it up, and says as his solatium: "After all, I've not broken my vow."

The Chinese have a story of a tiger who desired to eat a fox, but the latter claimed exemption as being superior to the other animals, adding that if the tiger doubted his word, he could easily judge for himself. So the two set forth, and, of course, every animal fled at sight of the tiger, who, too stupid to see how he had been gulled, conceived high respect for the fox, and spared his life.

Sometimes the tables are turned. Chanticleer gets his head out of Reynard's mouth by making him answer the farmer, and in the valuable collection of Hottentot tales which the late Dr. Bleek, with some warrant, called "Reynard in South Africa," the cock makes the jackal say his prayers, and flies off while the outwitted beast folds his hands and shuts his eyes.

But I must forbear quoting further. Enough if it is made clearer to the reader that the Beast-fable is the lineal descendant of barbaric conceptions of a life shared in common by man and brute, and another link thus added to the lengthening chain of the continuity of human history.

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.

CHIEFLY FOR THE SEASIDE.

By Richard A. Proctor.

(*Continued from page* 70.)

IN my last I described the Bedford level experiment in which use was made of a telescope *t* at A, (Fig. 3 *bis*) and of a disc *b* at B three miles off, to determine the deviation of the line of sight from *t* to *c* (another disc at C) six miles off, from the disc *b*,—*t*, *b*, and *c* being all at exactly the same height above the water surface A B C. The result was, to show *b* several times its own diameter above *c*, a simple and decisive proof that the points *t*, *b*, *c*, were not in a straight line,—as of course they would have been if the water surface were plane and therefore A B C a straight line.

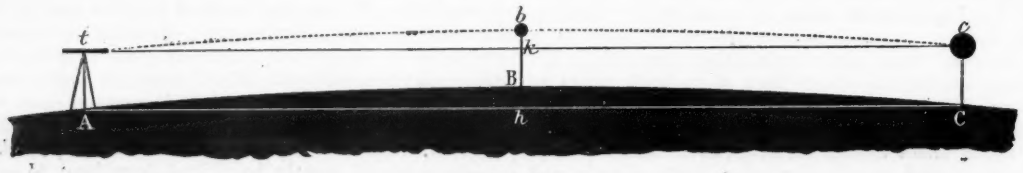


Fig. 3, *bis*.

To direct the telescope *t* to *c* it had to be slightly depressed, at least if *c* were brought exactly to the centre of the field of view. But it seems that although the telescope was apparently level—indeed one account says that it was carefully levelled—the distant disc *c* appeared to be in the centre of the field, absolutely coincident with the intersection of two cross-hairs marking the centre of the field. On the strength of this observation the loser claimed that the stakes should be handed to him. The claim was natural enough, and no doubt honestly made. Doubtless, also, the loser was convinced then and he may even be convinced still that wrong was done to him in the rejection of his claim. Be this as it may, it was probably unfortunate for him that he was thus led astray, as there is every reason to believe that his stake would have been returned to him by the winner but for the wild and angry ways into which this mistaken notion caused the loser to indulge.

Now let us inquire where his mistake lay. We shall thus be led to a proof of the earth's rotundity which though not so simple and striking as the one described at page 69, is really as convincing. It can readily be tested at the seaside by any one of ingenious and handy turn.

In the plan illustrated in Fig. 3, the disc *b* may be regarded as part of the apparatus employed to measure the depression of *c*. Of course *b* is itself depressed below the true horizon plane through *t*, but *c* is depressed four times as much, and therefore seen below the disc *b* in the telescopic field. In the other test, the disc at *b* is not used to help the observer. Let us see what remains to show the earth's rotundity.

Consider the geometry of the matter. It is simple enough:—Let A, B, C, &c., Fig. 5 represent the same points as the same letters in Fig. 3. Draw $t\,b'\,c'$ square to $t\,A$ producing B b and C c to meet $t\,c'$ in b' and c' respectively. Also join $t\,b$, and produce to meet C c in c''. Then we know that the angle $c\,t\,c'$ is equal to the angle in the alternate segment of the large circle of which $t\,b\,c$ is a part,

The loser of the wager asserts that the signal c (not the central point c) was on the line $h\,h'$, though admitting that b was above c. Thus if the centre of c was on $h\,h'$ the centre of b was above $h\,h'$; and if the centre of b was on $h\,h'$ the centre of c was below $h\,h'$. Either result would suffice to show that the explanation based on the straightness of the line $t\,b\,c$ was certainly erroneous. *Both* b and c

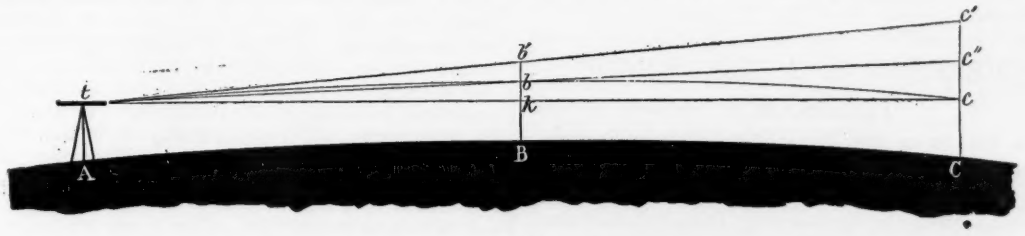


Fig. 5.

and therefore to twice the angle $b\,t\,c$ on the arc $b\,c$ (which is half of $t\,b\,c$). Hence, the lines B b', C c' being approximately parallel, we see that

$$b\,b' = k\,b = 6 \text{ ft. approximately;}$$
$$c\,c'' = c'\,c' = b'k = 12 \text{ ft. approximately;}$$
and $$c\,c' = 2c\,c'' = 24 \text{ ft. approximately.}$$

Now when the telescope at t is truly levelled it is so directed that its optical axis is in the straight line $t\,b'\,c'$,—so that as the disc c lies in the direction $t\,c$, while b lies in the direction $t\,b\,c''$, we ought if the centre of the field were exactly marked to see b below that centre by a certain small distance and c twice as far below that centre. Regarding these as small dots, we should see what is shown in Fig. 6 where a marks the intersection of the cross lines, b the centre of disc b, and c the centre of the remoter disc c.

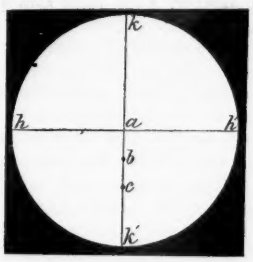


Fig. 6.

All this is nearly as obvious as what we found in the other test, only not quite so simple. If our telescope were perfectly levelled, the horizontal cross hair $h\,h'$ absolutely central, b removed, and c were found to be exactly on $h\,h'$, then—why then—Well, if the sky were to fall we should catch larks. The earth-flatteners should hardly expect astronomers even then to admit that the earth is flat, simply because there are a hundred other absolutely overwhelming proofs that the earth is a globe. It would be difficult to explain such an anomaly as would thus be indicated. Either it would appear that the water surface A B C unlike the ocean surface, or any other liquid surface, was absolutely plane, perhaps through some abnormal local attractions—or else it would appear that some abnormal refractive action of the atmosphere had raised c up to the true horizon of t. Not one jot would or *could* the faith of astronomers in the rotundity of the earth, proved a hundred ways, waver before such evidence. But, of course, no such evidence has ever been obtained.

were not on $h\,h'$, as they must both have been had the straight line from t to c been in the real horizon.

We *know* then already that either the observation on the strength of which c was supposed to be on $h\,h'$ was but rough, or else the instrumental adjustments were imperfect, the telescope not truly levelled, or $h\,h'$ not truly across the centre of the field.

But let us see how great the distance $a\,c$ in Fig. 6 should have been, supposing the adjustments all *perfect*. Suppose the magnifying power of the telescope to have been 12, that being about the utmost magnifying power likely to be used in a levelling experiment of the kind—for long telescopes are never used with exact adjustments to bring the optical axis level. Then we have $c\,c'$ (Fig. 5)=24 feet. But atmospheric refraction practically reduces $c\,c'$ by about a fourth leaving 18 ft. only. Thus the angle $c\,t\,c'$ as observed with the naked eye (*i.e.*, as distinguished from the geometrical angle $c\,t\,c'$) is the angle subtended by 18 ft. at a distance of six miles or of eighteen times 1760 ft. This is the angle subtended by 1 ft. at a distance of 1760 ft., or by 1 inch at a distance of 1760 inches, or by the hundredth of an inch at a distance of nearly 18 inches. As the telescopic magnifying power increases this angle twelvefold, we have the angle actually observed with the telescope equal to that subtended by the hundredth of an inch at a distance of $1\frac{1}{2}$ in. It is exactly one-tenth of the angle B O A in Fig. 7, and is fairly represented by the dark line B O pointed at end O.

Fig. 7.

Is it likely that an unpractised observer (all the observers in the Bedford experiment were unpractised) would detect the depression of the distant signal c below $h\,h'$ by this small angle—the signal not being a point but a disc—even if the cross hair $h\,h'$ had been precisely adjusted to correspond with the real horizon? But it is exceedingly unlikely that $h\,h'$ was properly adjusted. If not, and there are few nicer adjustments in practical surveying, it is certain that none of the observers employed could have even detected, far less have corrected, the error.

This particular test, then, under the conditions existing, was practically worthless,—the appearance of c below b was a hundred times better as a test, and indeed of itself proved (if the loser's statement about c being on the cross hairs can be trusted) that the levelling of the telescope and the adjustment of the horizontal cross hair were inexact.

XUM

But there is a pretty way of testing the depression of the water horizon due to terrestrial rotundity, which requires no telescope, and only a little care in execution. Parallax used the method, in a purposely inexact way to show the earth to be flat.

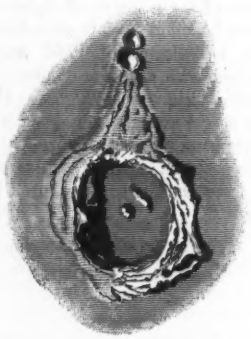
This method will be considered in our next.

(To be continued.)

THE MOON IN A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

WHEN the Moon is nine or ten days old, the Bay of Rainbows (P in our map) presents a perfectly charming spectacle to the observer. This great, dark, semi-circular area appears absolutely level in the instrument we are using, but is surrounded by a mass of stupendous cliffs. It measures, from Cape La Place (134) to Cape Heraclides (135), nearly 135 miles. Heraclides rises some 4,000 feet above the level of the bay, but is as a mere hillock compared with some of the neighbouring highlands. As we travel in an easterly direction we arrive at Sharp (139), 15,000 feet in height, and some of the peaks in this chain probably attain an altitude approaching to 20,000 feet. Nearly due south of Cape La Place lie two little, but exceedingly deep craters—the Eastern one of which, Helicon, is marked 129 in the map. And now we arrive at a region covered with systems of light streaks, akin to those described on p. 56 as emanating from Tycho. Euler (125), a fine ring plain, 19 miles in diameter, with a central peak, is the centre of one of these systems of rays. Tobias Mayer (117), 22 miles across, is an interesting object under suitable illumination. Of all the formations, however, in this region of the Lunar surface, there is nothing to compare with that superb one, Copernicus (112),

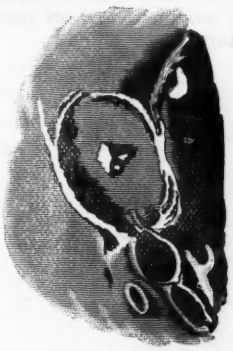


Copernicus. Moon's Age, 10·27 days.

our sketch of which above was taken with a power of 160, when the moon's age was 10·27 days. This magnificent ring-plain measures 56 miles across. There are, altogether, eight peaks rising from the interior—three bright ones, and four less so. With the instrument employed, however, and under the conditions of illumination then obtaining, two only of these were, as will be seen, visible at the epoch of our drawing. The terraced character of the wall is conspicuous enough, even in a 3-in. telescope, as is the disturbed and complicated character of the region immediately surrounding it. Two deep craters south of Copernicus, approximating in appearance to the figure 8, will at once strike the eye. So also will a conspicuous peak on the western wall, which is between 11,000 and 12,000 ft. high. The somewhat angular character of the contour of the wall is well seen from the shadows cast towards the east. Other features will strike the attentive observer. At full moon, Copernicus is seen to be the centre of a system of light streaks, uniting with similar ones from other formations, to which we shall hereafter refer. It is worthy of note that the streaks extending in a westerly direction from Copernicus are the most numerous; though those which lie towards the north are individually more conspicuous. There is an enormous number of tiny craters between Copernicus and Eratosthenes (110); but even the largest of these require favourable illumination and conditions, to be seen in our instrument. Reinhold (114), 31 miles across, will repay scrutiny while the telescope is turned on this part of the moon's visible disc. Euclid (221), and Landsberg (222), furnish examples of craters surrounded by a kind of nimbus or light ring. This, as will be seen on examination, differs in appearance from the streaks emanating from Tycho, Copernicus, Kepler, and Aristarchus. Kepler (144), by the way, may be here referred to as a crater, close upon 22 miles across, the centre of a great system of light streaks, uniting with those from Copernicus. Close to Euclid lie the Riphæan Mountains (220). Under oblique illumination they strongly suggest an exaggerated, or caricatured, bas-relief of a llama or giraffe. One of the deepest craters in the Sea of Clouds is Bullialdus (213), to which a light streak extends (as mentioned on page 56) from Tycho (180). This is 38½ miles across, with finely-terraced walls of considerable breadth, and a fine central mountain 3,000 feet high. The considerable crater or ring-plain, breaking into the southern wall, too, will at once strike the eye, while a very similar one (but detached from Bullialdus proper) will be noted to the south of this again. Campanus (226), a ring 30½ miles across, in this neighbourhood, is chiefly remarkable for the darkness of its interior. Hainzel (237) is a kind of pear-shaped ring-plain, 55 miles in its longest diameter, with high and precipitous walls rising some 11,600 ft. in places. The wall of Capuanus (238), too, will repay examination under suitable illumination. Capuanus is one of the comparatively few craters that remain conspicuous and identifiable when the Moon is full. We are now in the neighbourhood of the Sea of Moisture (T in our map). The student may begin his examination of this region with the large bay in this "sea," Hippalus (225). The chief interest, however, attaching to this locality resides in the wonderful system of "rills," or narrow and tortuous clefts, existing to the west of Hippalus. The majority of these require a large instrument for their detection, but one or two of them are within the reach of a three-inch telescope when the Moon is between nine and ten days old. The formation of Vitello (229) seems to afford an illustration of the vulgar phrase, "a wheel within a wheel," inasmuch as the outer ring-plain encloses another one, from the interior of which rises a mountain, 1,600 ft. or 1,700 ft. high. With the examination of Gassendi (232), on the northern boundary of the Sea of Moisture, we shall conclude another night's work.

Our sketch of this fine and interesting formation was made with a power of 160, the moon being 11·24 days old, and Gassendi very nearly on the terminator. The diameter of this great walled plain is fifty-five miles. The height of its surrounding cliffs varies greatly; in places they rise to an altitude of some 10,000 feet, while towards the south, as will be seen in the drawing we give, they diminish to a twentieth part of that height. It is worthy of remark that Mädler asserts that the floor of Gassendi is in its northern part quite 2,000 feet above the level of the almost adjoining Sea of Moisture. It will be observed how the northern part of the wall has been destroyed by the subse-

quent eruption in which the great spoon-shaped ring plain shown was formed. At the epoch of our sketch, the three central mountain masses, rising from the principal plain, were conspicuously shown. It will be seen that the westernmost of these is the largest and highest, the tips of the



Gassendi. Moon's age, 11·24 days.

others only peeping, as it were, out of its shadow. This is a formation which may be advantageously studied continuously during the eleventh and twelfth days of the moon's age, as it exhibits so many complicated features; and it is most instructive to the beginner to note how these come into view, and alter in aspect with advancing sunlight. Moreover, the student should observe it in different states of the moon's libration.* The changes produced in the aspect of formations in the neighbourhood of the moon's limb from this cause are most striking and remarkable.

(To be continued.)

WEATHER FORECASTS,

AND HOW TO MAKE THEM.

By John Browning, F.R.A.S.

INTRODUCTION.

NEARLY all the readers of Knowledge, I imagine, turn to the portion of their daily newspaper which contains the forecast of the weather issued by the Meteorological Committee of the Board of Trade at 8.30 p.m. on the previous day, to see what weather is predicted. Very various are the opinions as to the accuracy of these predictions, some declaring them to be nearly always right, while others say they are nearly always wrong. My own opinion, after noting them carefully for years, is, that where the weather is alike over large areas, the forecasts are in the main correct; and when the weather is partial, observations taken at a number of points in either of the areas would show the forecast for that area to be fairly correct. But with partial weather, which we so often experience in England, many persons will find the prediction proves inaccurate. The only remedy for this is to forecast the weather for each district for ourselves.

After the experience of several months, I am satisfied that this may be done with considerable accuracy. I was first induced to give my attention to this subject from my desire to know when I might undertake long journeys on a tricycle with a fair prospect of fine weather. But a very little consideration will show that the matter is one of national importance. There is enough good weather probably in the worst seasons to get in all standing crops safely if agriculturists only knew when to expect it and could take advantage of it. What is greatly required, is accurate predictions of the probability of rain. The weather forecasts of the Board of Trade are nearly always correct as regards the direction and force of the wind. Now to foretell rain it is well-known that the barometer is useful, but it should not be relied on solely, as there are two instruments which give indications that are more serviceable; these are the Rain-band Spectroscope and the Weather Compass.

THE RAIN-BAND SPECTROSCOPE.

To refer first to the rain-band spectroscope. For years it was known that there were many lines in the solar spectrum which could not be identified with the lines given by any of the metals. It was noticed that these lines were more numerous about sunrise and sunset. Jannssen, the French astronomer, showed that these lines were due to moisture—that is, the vapour of water being present in our atmosphere. The increase in their number and intensity about sunrise and sunset is due to the fact that the sun's rays at those times pass through a large amount of our atmosphere.

The proof that Jannssen gave of the source of these lines, though exceedingly simple, was convincing. He placed a bright light of burning coal-gas, or oil, at one end of an iron tube thirty feet long, and a spectroscope at the other end. The spectrum of the bright flame seen in this way was, of course, a continuous spectrum without any lines. Then he closed both ends of the tube with plates of glass, and filled the tube with transparent steam. The spectrum of the light seen through the steam contained a great number of fine lines which corresponded with those seen in the solar spectrum near sunset, and were most numerous near the red end of the spectrum.

Professor Piazzi Smyth first observed that these lines were more numerous in the spectrum before a fall of rain, and proposed to use them for the purpose of predicting rain. But he used in his experiments a powerful and expensive instrument—difficult to use and too expensive for general adoption. Mr. J. Rand-Capron has recently found that equally good results may be obtained by using a spectroscope, which can be bought for as many shillings as the original instrument cost pounds.

In his small pamphlet, "A Plea for the Rain-band," reprinted from the *Meteorological Magazine*, Mr. Rand-Capron has described his method of using the smaller instrument.

The original papers, both of Professor Smyth and Mr. Rand-Capron, were, of course, addressed to the scientists. The editor of Knowlege having kindly asked me for some papers on this subject, I shall try my utmost to make my instructions for using the instrument as clear as possible.

(To be continued.)

THE FISHERIES EXHIBITION.

By John Ernest Ady.

IV.

IN our last contribution we proposed to take a glance at the sponges which adorn some of the cases in the Exhibition, and to show how they came to occupy their present place in the system of zoology. At the outset we may state that their true systematic position has been only recently established, through technical methods of research

* For an explanation of lunar libration, see "The Moon," by the editor of Knowledge (Longman & Co.), pp. 118, *et seq.*

XUM

into their minute structure and developmental history, without which their real nature could never have been determined. This, then, affords an explanation of how it was that the older naturalists looked upon them as plants, and subsequently regarded them as composite animals of a primitive type.

The sponges are amongst the most useful and beautiful objects in the Exhibition. Their utility is obvious to everyone in the civilised world, and particularly to a large community of individuals who depend for their living entirely upon the sponge fisheries.

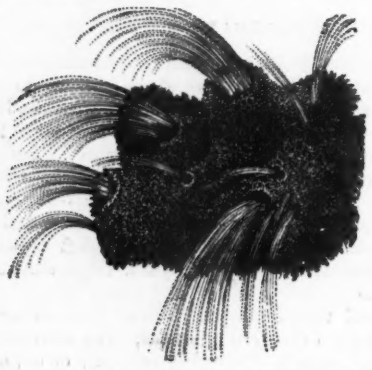


Fig. 8.—Commercial Sponge, showing outgoing currents of water.

In modern times the chief sponge fisheries are confined to the regions around the Bahamas and in the Mediterranean Sea, especially in the Grecian Archipelago, and the respective products of both localities are well represented in the foreign gallery of the Exhibition buildings which runs parallel with the aquarium.

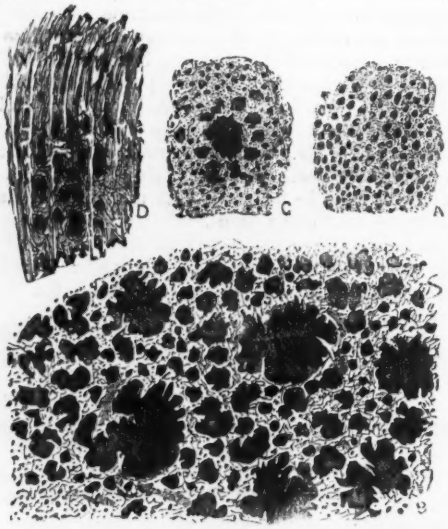


Fig. 9.—Outer surface of different kinds of sponge (natural size). A, cup-shaped variety; B, honeycomb sponge; C, toilet-sponge; D, Bahamas sponge, partly in sections, showing projecting extremities and internal tubular character.

Let us confine our attention at present to the external forms presented by these sponges, and revert in future communications to their anatomical characteristics and affinities.

There are thousands of sponges which are of no commercial value, either from a strictly utilitarian or an æsthetic point of view. The useful sponges, known as the sponges of commerce, belong to one small group, the *Spongia*, of which Fig. 8 is an example; they are divided into two principal subdivisions: 1. The common sponges (*Spongia officinalis*) of large rounded or flat forms, soft tissue, convex beneath, and of coarse texture. 2. The fine sponges (*Spongia usitatissimum*) of concave or cup-like form and fine texture.

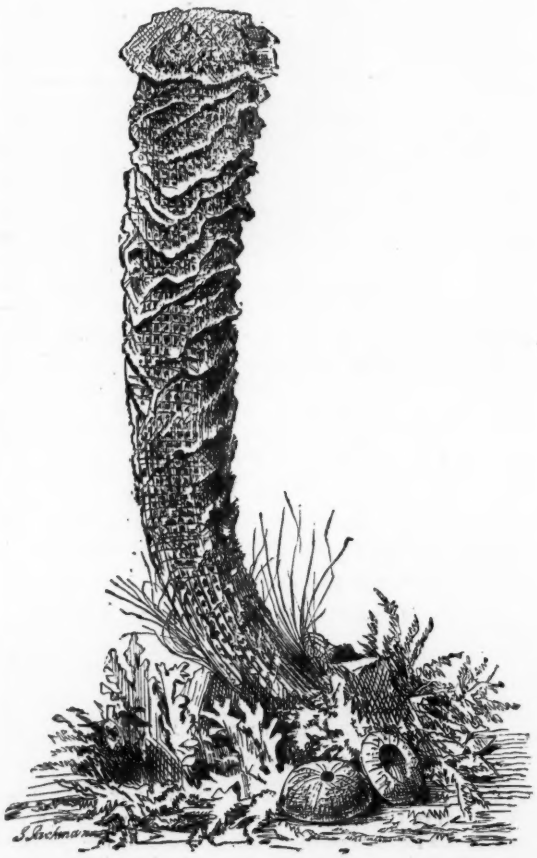


Fig. 10.—Siliceous skeleton of Venus's flower-basket, *Euplectella speciosa*.

It must be borne in mind that we are now speaking merely of the commercial article sponge, and not of the living animal of that name. The former is merely the skeleton of the latter, and consists, in the case of the sponges of commerce, entirely of a horny material called *keratose*, in the form of fine fibres matted together in such a way as to leave numerous large apertures and smaller pores throughout its substance. Fig. 9 shows these differences in texture of some of the principal sponges of commerce. As a rule, the sponges of the Mediterranean are finer than those of the West Indies; they are, therefore, of higher value for domestic purposes. The usefulness of the sponge must also largely depend on the purity of the fibres of its keratose skeleton and their elasticity, for upon these qualities do their absorbent powers depend.

But some of the sponges of commerce live under such adverse circumstances, amidst *débris* of all kinds, that particles of grit, &c., become inextricably woven into their

skeletons. Such varieties are used in America for stuffing cushions, bedding, and other upholstery work.

Yet other keratose sponges possess, in addition to their fibrous network, a number of siliceous spicules, which strengthen their skeletons, and also lie embedded in their fleshy substance (*e.g. Spongilla, Halichondria*); they are, therefore, of no special commercial value, although, as we shall show later on, they are of vast interest to the naturalist.

When the siliceous spicules predominate, and, finally, when they entirely take the place of the keratose, the sponges are known as siliceous; and amongst these are some of the most beautiful forms in nature. Fig. 10 is but a poor representation of the delicate beauty of one of these forms which occurs around the region of the Philippine Islands, and several specimens of which may be viewed in the Exhibition; more notably in Lady Brassey's *Sunbeam* collection, and in two beautiful groups encased in dome-shaped glasses at the end of the Natural History Galleries. We shall have occasion hereafter to give a brief description of the structure of these and other sponges.

We are indebted for these figures to the kindness of Messrs. Griffith & Farran, of St. Paul's Churchyard, from whose work, "The Commercial Products of the Sea," by P. L. Simmonds, they have been derived.

SEA ANEMONES

AT THE FISHERIES EXHIBITION.

By Thomas Kimber.

II.—THE WHITE CARNATION.

Actinoloba dianthus (Blainville). *Actinia pentapetala* (Penn).

THIS is one of the largest of the British sea anemones, and also one of the handsomest. Large specimens—over a dozen of the purest white—may be seen in No. 10

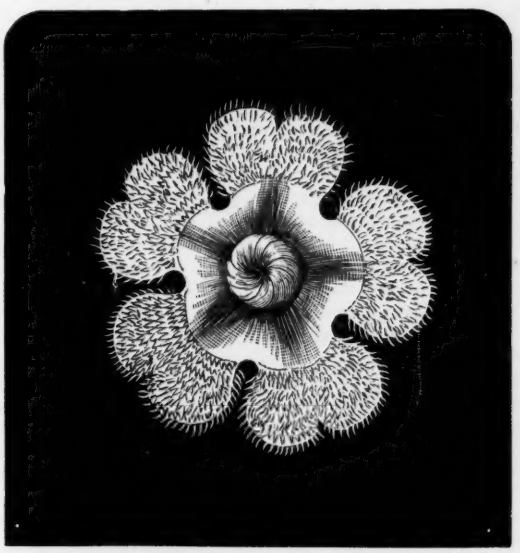


Fig. 1.—Disk, showing five principal lobes subdivided, mouth, &c.

tank, and still larger—4 or 5 inches across and 6 in height—in some of the other tanks; while there are young midgets not larger than a pea, with all intermediate sizes.

Fig. 1. *The disk, &c.*—In this species the principal lobes or petals vary in number from five to eight or nine, and each lobe is frequently subdivided and voluted, so that the entire disk, though truly circular in outline, will not expand into a plane surface. The tentacles are numerous in the adult near the mouth, and moderately long, but shorter near the margin; and the edges of each lobe and its sub-divisions are fringed with fine short tentacles that defy numeration. When the disk is much convoluted, as is usual in large specimens, it assumes a semi-globose form, and has a feathery surface. Hence the expressive name *plumosa*, given to this anemone by several writers. The mouth has a thick lip, divided into lobes, and is generally rufous or orange, whatever the general colour of the animal may be.

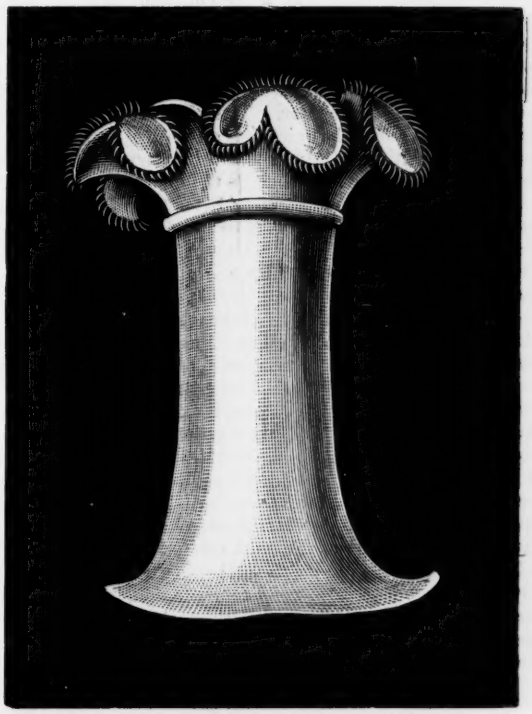


Fig. 2.—Column, edge of disk, &c.

Fig. 2. *The column, &c.*—A full-grown specimen in flower, as here shown, is a very beautiful object, and the greatest possible attraction to any aquarium. At the summit of the column is a thick, round rim, like a ring, and behind it the fosse. The base is always very much broader than the rest of the body. The white variety, which Figs. 1 and 2 illustrate, is not at all uncommon, and to it is universally conceded supremacy in beauty. Generally speaking, whatever the hue, it is uniform throughout in the same specimen. The commonest varieties are probably buff and cream colour, and then pale red. Amber, dark brown, and olive are comparatively rare varieties. The brown and olive examples have whitish tentacles, marked with an opaque bar. Several good examples of the olive dianthus with smoky-white disk, occur in the Exhibition.

The Button.—This anemone is exceptionally flat when closed, and to-day (July 31), in 10 tank, are good instances of the button form, both white and buff, and in different sizes. The outline of a large one is quite irregular, perhaps five inches across, thin as a card at the edges, and in the centre not more than the eighth of an inch in thickness.

XUM

Small shrimps in the tank are constantly approaching the disk, a dianthus, and dart away several inches, as if stung, on touching the tentacles. The instantaneous movement has quite the appearance of being the result of an electric shock.

Individuals of this species seem to vary in character. There appears to be a "quiet family," and a race much given to movement. Some of the more lively frequently change the contour of their figures, at one moment appearing tall and straight as a marble column, and the next constricted immediately below the margin (as if very fashionably laced), so that the fringed lobes droop over like a lily. This singular construction then gradually moves downwards, and, when half-way, gives the animal the form of an hour-glass. Gradually it descends almost to the base, but very soon moves up again, and the process is then reversed, until the lovely lily-like form is restored. This most interesting performance will sometimes continue for an hour together, the animal never retaining its ordinary shape for a minute at a time. The same individual will at other times be perfectly quiet for an entire day, the only perceptible motion being in the ever-varying fringe of down-like tentacles which encircle the disk.

Actinoloba is the name given by Blainville, 1834, and followed by Gosse, 1860. It is, or should be, derived from ἀκτίν a ray, and λοβὸς a lobe, and means an animal with lobed tentacles. The term *dianthus* is said to be thus named (δῖο divine, ἄνθος flower), from its extreme beauty. Müller has named dianthus *Actiniarum pulcherrima*, the most beautiful of all anemones, and so far as this verdict relates to European species, it is admitted to be just. Writers vie with each other in its praise. The whole creature, one aptly declares, is exquisitely lovely, and can be compared only to the most graceful flower formed of rich white or amber feathers. Besides its extreme beauty of outline, the contrast in colour between this lovely creature and the medium in which it lives and moves is equally striking, and generally arrests the attention and elicits the admiration of the most careless observer.

The next paper will give a further account of dianthus with respect to locomotion and reproduction, how to obtain specimens and keep them in health, with a description of the gorgeous examples obtained by the United States exploring expedition.

A STEAMER GOES SAFELY PAST NIAGARA WHIRLPOOL.*

IN the year 1846, a small steamer was built in the eddy just above the railway Suspension Bridge to run up to the Falls. She was very appropriately named—*The Maid of the Mist.* Her engine was rather weak, but she safely accomplished the trip. As, however, she took passengers aboard only from the Canada side, she did little more than pay expenses. In 1854 a larger, better boat, with a more powerful engine, the new *Maid of the Mist* was put on the route, and many thousands of persons made this most exciting and impressive tour under the Falls. The admiration which the visitor felt as he passed quietly along under the American Fall was changed into awe when he began to feel the mighty pulse of the great deep just below the tower; then swung around into the white foam directly in front of the Horse-shoe and saw the sky of waters falling toward him. And he seemed to be lifted on wings as he sailed swiftly down on the flying stream through a baptism of spray. To many persons there was a fascination about it that induced them to make the trip every time they had an opportunity to do so. Owing to some change in her appointments, which confined her to the Canadian shore for the reception of passengers, she became unprofitable. Her owner having decided to leave the place wished to sell her as she lay at her dock. This he could not do, but had an offer of something more than half of her cost, if he would deliver her at Niagara, opposite the Fort. This he decided to do, after consultation with Robinson, who had acted as her captain and pilot on her trips under the Falls. The boat required for her navigation an engineer, who also acted as a fireman, and a pilot. On her pleasure trips she had a clerk in addition to these. Mr. Robinson agreed to act as pilot for the fearful voyage, and the engineer, Mr. Jones, consented to go with him. A courageous machinist, Mr. McIntyre, volunteered to share the risk with them. They put her in complete trim, removing from deck and hold all superfluous articles. Notice was given of the time for starting, and a large number of people assembled to see the fearful plunge, no one expecting to see either boat or crew again, after they should leave the dock. This dock, as has been before stated, was just above the railway Suspension Bridge,* at the place where she was built, and where she was laid up in the winter; that, too, being the only place where she could lie without danger of being crushed by the ice. Twenty rods below this eddy the water plunges sharply down into the head of the crooked, tumultuous rapid which we have before noticed, as reaching from the bridge to the Whirlpool. At the Whirlpool the danger of being drawn under was most to be apprehended; in the Rapids of being turned over or knocked to pieces. From the Whirlpool to Lewiston is one wild, turbulent rush and whirl of water without a square foot of smooth surface in the whole distance.

About three o'clock in the afternoon of June 15, 1861, the engineer took his place in the hold, and, knowing that their flitting would be short at the longest, and might be only the preface to a swift destruction, set his steam-valve at the proper gauge, and awaited—not without anxiety—the tinkling signal that should start them on their flying voyage. McIntyre joined Robinson at the wheel on the upper-deck. Self-possessed, and with the calmness which results from undoubting courage and confidence, yet with the humility which recognises all possibilities, with downcast eyes and firm hands, Robinson took his place at the wheel and pulled the starting-bell. With a shriek from her whistle and a white puff from her escape-pipe to take leave, as it were, of the multitude gathered on the shores and on the bridge, the boat ran up the eddy a short distance, then swung around to the right, cleared the smooth water and shot like an arrow into the rapid under the bridge. She took the outside curve of the rapid, and when a third of the way down it a jet of water struck against her rudder, a column dashed up under her starboard side, heeled her over, carried away her smoke-stack, started her overhang on that side, threw Robinson flat on his back and thrust McIntrye against her starboard wheel-house with such a force as to break it through. Every eye was fixed; every tongue was silent, and every looker-on breathed freer as she emerged from the fearful baptism, shook her wounded sides, slid into the Whirlpool and for a moment rode again on an even keel. Robinson rose at once, seized the helm, set her to the right of the

* From "Niagara: Its History and Geology." By Geo. W. Holley.

* See the map in our last. We hope to give next week a view of the Whirlpool Rapids, from a photograph in the Editor's possession.

large pot in the pool, then turned her directly through the neck of it. Thence, after receiving another drenching from its combing waves, she dashed on without further accident to the quiet bosom of the river below Lewiston.

Thus was accomplished the most remarkable and perilous voyage ever made by men. To look at the boat and the navigation she was to undertake no one would have predicted for it any other than a fatal termination. The boat was seventy-two feet long with seventeen feet breadth of beam and eight feet depth of hold, and carried an engine of an hundred horse-power. In conversation with Robinson after the voyage, he stated that the greater part of it was like what he had always imagined must be the swift sailing of a large bird in a downward flight; that when the accident occurred the boat seemed to be struck from all directions at once; that she trembled like a fiddle-string and felt as if she would crumble away and drop into atoms; that both he and McIntyre were holding to the wheel with all their strength, but produced no more effect than if they had been two flies; that he had no fear of striking the rocks, for he knew that the strongest suction must be in the deepest channel, and that the boat must remain in that. Finding that McIntyre was somewhat bewildered by excitement or by his fall as he rolled up by his side but did not rise, he quietly put his foot on his breast to keep him from rolling round the deck, and thus finished the voyage.

The effect of this trip upon Robinson was decidedly marked. To it, as he lived but a few years afterward, his death was commonly attributed. But this was incorrect, since the disease which terminated his life was contracted at New Orleans at a later day. "He was," said Mrs. Robinson to the writer, "twenty years older when he came home that day than when he went out." He sank into his chair like a person overcome with weariness. He decided to abandon the water, and advised his sons to venture no more about the Rapids. Both his manner and appearance were changed. Calm and deliberate before, he became thoughtful and serious afterward. He had been borne, as it were, in the arms of a power so mighty that its impress was stamped on his features and on his mind. Through a slightly opened door he had seen a vision which awed and subdued him. He became reverent in a moment. He grew venerable in an hour.

Yet he had a strange, almost irrepressible desire to make this voyage immediately after the steamer was put on below the Falls. This wish was only increased when the first *Maid of the Mist* was superseded by the new and stauncher one. He insisted that it could be made with safety, and that it might be made a good pecuniary speculation.

The total number of visitors to the Fisheries Exhibition reached 1,000,000 during the course of Tuesday, the last day of July, that is to say, within sixty-eight days of the opening on Whit Monday. This gives an average of about 14,700 visitors per diem. The two largest days were Whit Monday and Tuesday, with 42,941 and 29,446 visitors respectively.

For cementing rubber or gutta-percha to metal Mr. Moritz Grossman, in his "Year Book" for 1883, gives the following recipe:—Pulverised shellac, dissolved in ten times its weight of pure ammonia. In three days the mixture will be of the required consistency. The ammonia penetrates the rubber, and enables the shellac to take a firm hold, but as it all evaporates in time, the rubber is immovably fastened to the metal, and neither gas nor water will remove it.

PRINCIPLES OF DRESS REFORM.

By E. M. King.

It is the theory of Herbert Spencer that imperfection in mankind is due to its being out of harmony with its surroundings. That "all evil results from the non-adaptation of constitution to conditions." That this non-adaptation is caused by having a faculty in excess or a faculty that is deficient. That finally, by the working of an unalterable law, "all excess and all deficiency must disappear, that is, that all unfitness must disappear; that is, all imperfection must disappear." And, in this way, humanity must become completely adapted to its conditions, that is to say perfect.*

There seems to me to be a flaw in this reasoning. There is a tacit assumption that "conditions" are perfect, and therefore that if character is adapted to conditions it must necessarily become perfect also. But the conditions which surround men may not be perfect, they may tend to diminish a good faculty, and to increase a bad one, and this will not lead to perfection, but the reverse. Writers on social science whose works I have read do not seem to have recognised that mankind has two surroundings or conditions; his natural surroundings and his social surroundings. The former, or laws of nature, are fixed and inexorable; the latter, or social laws, are not as "H. S." affirms,† "sure and inflexible," but fluctuating, and continually made and unmade by society. I am not speaking here of mere social etiquette, but of all sociological laws.

We are conscious, daily and hourly, of the powerful influence of our social surroundings; they even appear to shut us out from, or blind our eyes to, the more sure, but less apparent, laws of nature. Very often the two sets of laws are at variance, and thus it happens that an individual may be perfectly in harmony with his social surroundings or conditions, but out of harmony with his natural surroundings or conditions. Our social surroundings, for a time at least, shield us from some of the pains and penalties of disobeying—or being out of harmony with—the laws of nature. When this state of contradiction, or antagonism, is arrived at, the punishment appears to be, by slow degrees, distributed from the individual to the class, or race, or nation which disobeys.

For instance, a man dealing dishonestly where there is a low standard of honesty in trade, suffers little from his social surroundings—he is in harmony with them, and they with him; but instead of himself and his trade moving on to perfection by this adaptation of constitution to conditions, he is moving on to degradation of character and his trade sinking to decay and ruin. Again, a man who lives an impure life, in a society which allows laxity of morals as excusable in men, is in harmony with his social surroundings, although he is at war with the laws of nature. His social surroundings are increasing his bad faculties and diminishing his good ones, and in the end that class, or race, or nation so degrading character to its social conditions, meets with its due reward.

Before humanity reaches perfection it has a two-fold work before it, not only to adapt character, or constitution, to conditions, but so to modify, alter, and improve these latter, that they shall be favourable to the highest development of his faculties, whether intellectual, moral, or physical.

Of necessity, then, the first step of every reformer must be to put himself out of harmony with his immediate or social surrounding or conditions. Socrates, Lloyd Garrison, and other such reformers, were all glorious men, who had

* "Social Statics," chap. 2. † *Ibid.*, p. 55.

XUM

a (good) "faculty in excess," which no laws, radical or social, could diminish. They voluntarily put themselves out of harmony with their surroundings, and had to endure the hate, abuse, ridicule, and misconstruction which their disobedience to the social laws of the time entailed upon them.

The fashionably-dressed woman is completely in harmony with her surroundings. She feels this in herself by a delightful sense of self-complacency. Society pets her, and "pays attention" to her, for, on the whole, society likes fashionably-dressed women, however much fashion in the abstract may be abused. But the more the fashionable woman is in harmony with her surroundings, and the more society is in harmony with her, so much the worse for society and for women.

When people condemn fashion, they usually mean only the most glaring violations of good taste which they may happen to observe—especially if it is personally inconvenient to them—which fashion from time to time introduces. And this is generally only objected to on its first appearance, for the eye soon gets reconciled to it and ceases to object, and so the harmony between the fashionable woman and her social surroundings is soon re-established. While this even balance is kept up no reform can be expected to arise on either side.

Something more is required than this occasional protest against, and avoidance of, the passing fashion-folly of the day.

We must look a little deeper, and see what it is in ourselves and in our ordinary mode of dress which makes us liable to be caught by, and made victims of, the contagious disease of Fashion.

It is this: that our ordinary mode of dress is not constructed with any reference to the requirements of the body, nor to the beauty of its natural form. It has, therefore, no firm and lasting basis in Reason. Nothing from which beauty can naturally grow as out of a stem—nothing upon which to base the eternal canons of loveliness—nothing, in short, which can permanently ensure us either fitness or beauty in our dress. Until, therefore, we lay the right foundation, any utility or beauty which those who pander to our morbid desire for change may offer us, will only come by chance or accident, and be swept away by the next turn of the tide.

From my point of view, then, with regard to dress reform, the necessity, scope, and aim of which I have endeavoured logically to put before your readers, my fifth requirement—that we must not depart too conspicuously from the ordinary dress of the time—means that we must depart a little conspicuously. Bear in mind that for this, as for every other reform, two things are necessary—reform of the individual, and reform of the social medium in which the individual lives, and though the first process may be done in secret, every true-hearted and courageous reformer is bound to go on to the second, and is called upon to take a step which must, for the time, put him out of harmony with his surroundings.

Dress appeals to the eye. It is through the eye that society has been educated in bad taste, and that our social surroundings tend to the increase of women's bad faculties and to the decrease of their good ones. We must therefore begin this second process by an appeal to the eye, in however small a degree, so as gradually to modify, alter, and finally change the condition of our social environment, so that it may become favourable to the development of our best faculties, moral, intellectual, and physical.

For this reason also (that dress appeals to the eye) I have struck here the keynote of beauty rather than of health, though on this latter head as much, or more, remains to be said which has not yet been said.

Those who are alive to the necessity of reform must be content to remain in a state of change or transition until the twofold revolution in mind and act is completed. This is not the "morbid" desire for change, but the healthy desire for perfection. Those who desire progress in reform must dread any bars placed across the road. Such a bar, I consider, the advice of "Pedestrienne"—that a garment must be of a certain shape and a certain definite width in inches. Any hard-and-fast line of this kind is a bar to progress. Such a one as this induces women to think that in making some little paltry advance they have done all that is needful, and that they may after that go comfortably to sleep for the next generation or two.

No mental or moral faculty has been called into active exercise; they have simply accepted a fashion which some individual or some society has succeeded in inducing them to wear, just as they would have received it from the shops or the fashion-books.

I am so tired of hearing that women naturally shrink from making themselves "conspicuous." Everyone "naturally shrinks" from doing what is disagreeable to them, because every one naturally shrinks from the pain of putting themselves out of harmony with their surroundings. But this is no reason why they should not do their duty, and dress reform is the imperative duty of every woman who can think, and who can raise a finger to act.

But it is not the fact that women naturally shrink from making themselves conspicuous. The whole sex, both from natural and acquired propensities, loves to make itself conspicuous. In comparison with men, we may be called the personally-conspicuous sex. We ought, therefore, to be proud of being conspicuous in the cause of reason, as we have hitherto been in the cause of folly.

But I would spare my sex as much as possible not because we naturally shrink from making ourselves conspicuous, but because morbid self-consciousness and personal vanity have been so largely increased in us by our social environment that it gives us much greater pain than it does men to put ourselves out of harmony with it in a matter which touches so sharply on these tender points.

As far as I am able, I strive to act upon the social medium, so that as little pain as possible may be felt in taking this first painful step. More especially I address myself to men, by arguments which they (some of them) can follow and appreciate.

If they see flaws in my reasoning let them point them out. If they think them sound, let them help us.

The Pilsen-Joel and General Electric Light Company (Limited), which possesses in the Pilsen lamp one of the best arc regulators yet invented, have presented a petition for winding-up.

A Novel Literary Scheme.—In pursuance of a suggestion that the Parcels Post may be so utilised as to enable readers of current literature to see the magazines and reviews at a reduced cost, a central agency has been established for the promotion of this object. The scheme is, in brief, an adaptation of the principle of the circulating library, a selected parcel of periodical literature being passed on from one subscriber to another by mutual understanding. The experiment may be regarded with interest from several points of view; it is claimed that, if successful, it should rather increase than restrict the demand for current literature by placing it within the reach of a much larger class than hitherto. All particulars may be obtained of the Parcels Post Periodical Press Exchange, 160, Fleet-street, E.C.

CHEMISTRY OF THE CEREALS.

By William Jago, F.C.S.

No. III.

IT has been the object of the former two papers to give some idea of the nature and properties of that interesting group of compounds, starch, cellulose, and dextrin. Viewing these bodies in their relation to plant-life, there is every reason to believe that starch is the first-formed of the three; and that the plant, in the act of growing, draws on its store of starch for the production of cellulose, as that material is required for the building up of its structure. So far, the process is one of development: from one organised substance, another, to be used for a more special purpose, is formed. Coming to the dextrin, we find evidence, not of life, but of death; the starch-cells which, despite their minuteness, are so delicately fashioned, have lost all trace of structure, and are transformed into a perfectly homogeneous body. Notwithstanding this (as already known to the reader), the chemical composition is as yet unaltered, so far as the number of atoms composing the molecule is concerned. The starch undergoes yet another stage of degeneration within the grain, by which it is converted into sugar; the gum and sugar of the cereals having thus a common origin, are classed together in the analyses given at the commencement of these papers.

Starch, dextrin, and a number of other compounds are frequently termed "carbo-hydrates." This name is applied because they contain the element carbon combined with hydrogen and oxygen in the proportions of those elements necessary to form water. Thus $C_6H_{10}O_5$ may be viewed as six atoms of carbon and five molecules of H_2O, although the actual groupings of the atoms within the molecule is undoubtedly more complicated than this idea represents. Reference has been made to this classification as carbo-hydrates, because we thus have a connecting link between the starch group and sugar, for this latter body is also a carbo-hydrate, having the formula $C_6H_{12}O_6$. The number of carbon atoms is again the same; but instead of five, there are here six molecules of H_2O. Starch passing through the modifications of soluble starch and dextrin is changed into sugar by a very simple chemical operation:—

$$C_6H_{10}O_5 + H_2O = C_6H_{12}O_6.$$

To changes of this kind, which consist of the assimilation of the elements of water by a compound, the name "hydrolysis" has been applied. Starch and water if left to themselves do not readily combine to produce sugar, but their combination may be effected by a number of bodies which do not necessarily themselves undergo change during the hydrolysis. Several of the dilute acids may be used for this purpose; the saliva also possesses the property in a remarkable degree. This latter fact admits of easy experimental proof in the following manner. Make a tolerably stiff solution of arrowroot or cornflour by boiling with water only; let it cool, and when lukewarm, place a spoonful in the mouth, and mix it thoroughly with the saliva. Retain the mixture in the mouth, and very shortly the solution becomes thin and watery, and acquires a sweet taste; the starch has by that time become almost wholly converted into sugar. This change is also, under certain circumstances, effected by another group of bodies, and these are of special interest, because they are constituents of the grain itself.

Sugar is so familiar to all, that it becomes scarcely necessary to mention that it is a soluble body, and that its great and leading character is its sweetness. Its further properties must be dealt with somewhat later, and, as its production from starch is the foundation of some most important industries, we shall then describe these properties in detail. [The foot-note appended by the Editor to the last article of this series, giving a second version of the discovery of dextrin, affords a clue to one industry, at least, to which reference is here made.]

All grains contain a certain small proportion of fat. This is not, however, a very important constituent. Chemical analysis shows the fats to be compounds consisting of carbon, hydrogen, and a small proportion of oxygen.

We must in the next place turn our attention to remaining group of constituents of the cereals. These will be found in the table of analyses, given at the head of the first paper, classed under the term "albuminoids." The percentage varies from 7·2 in rice to 16·0 in oats: wheat again occupies an intermediate position, with a percentage of 10·9. The albuminoids differ essentially in chemical composition from the bodies we have heretofore studied, in that they contain in addition to carbon, hydrogen, and oxygen, the elements, nitrogen and sulphur. On analysis they are found, on the average, to consist of carbon 53·3, hydrogen 7·1, nitrogen, 15·7, oxygen 22·1, and sulphur 1·8 per cent. From these proportions it is impossible to deduce a simple formula. The sulphur is only present in small quantity, but as in a molecule we must have at least one atom, we can get no formula simpler than that calculated by Lieberkuhn, which is written $C_{72}H_{112}N_{18}O_{22}S$.

The albuminoids are so-called because, both in chemical composition and properties, they are strikingly like albumen; this latter substance is well known to everybody, occurring, as it does, in an almost pure form in white of egg.

When wheat-flour is made into a paste, and then washed with a large quantity of water, a separation into three distinct substances occurs. As already described, starch is one of these substances, and renders the washing water milky in appearance; gluten is another, and remains in the hand. It is a very sticky, elastic body, of a light-grey colour. On setting the washing water aside to rest, the starch falls to the bottom; remaining in solution there is, however, a little dextrin and sugar, and also another highly important substance, viz., vegetable albumen. The gluten on the one hand, and the vegetable albumen on the other, are two of the most important of the group of albuminoids; they represent respectively the soluble and the insoluble albuminoids; this of itself is a most important subdivision of the group. The soluble albuminoids consist of two separate bodies—vegetable albumen, and legumin or vegetable casein. On boiling the solution, the albumen coagulates, and is deposited in white flakes; the albumen thus obtained is to all intents and purposes identical with that of the white of egg and of blood.

Another albuminoid of importance is found in the husk or bran of wheat. This body is soluble in water, and possesses in a remarkable degree the property of converting starch into sugar; hence if an infusion of bran be added to starch solution, the latter speedily becomes thin and watery. As a result of this action, bread made of whole meal has always a specially sweet taste; this is often so pronounced that the bread after very short use becomes distasteful to many. Cerealin shares with some of the other albuminoids this peculiar property.

Gluten is quite insoluble in water, and has scarcely any taste; when dry, it closely resembles glue in appearance; in the grain, it exists in a pulverulent form, and acquires its toughness and elasticity on the addition of water. The toughness of gluten gives dough made from wheat-flour its peculiar elasticity, hence it becomes so deliciously light by

XUM

the production from any cause of air bubbles within its mass. Barley and other grains contain little or no gluten, and so do not yield the same highly elastic dough. Moist gluten putrefies with great readiness; in the manufacture of wheat-starch, the gluten is removed in this manner. Gluten is not a single compound, but may be separated into two bodies, known respectively as vegetable fibrin and glutin.

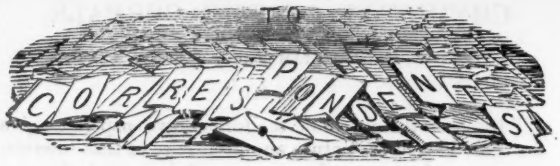
This brings us to the close of a very brief description of the principal constituents of the cereals. Our next paper must commence to deal with the chemistry of some of their uses. The production of bread will naturally occupy the first place in this series of studies.

Editorial Gossip.

I HAVE been told, by one who ought to know, that the analysis of Sir W. Herschel's papers by Messrs. Holden and Hastings referred to in the Gossip at p. 59 is good and trustworthy work. I willingly notify this. It shows that the same man who writing anonymously has been dishonest and untruthful is capable of better things when working in open daylight. The same correspondent who speaks with respect and something like gratitude (for reasons which I need not explain) of Holden's analysis of the elder Herschel's papers, appeals against my reference to a long-past offence against the unwritten laws of the literary commonwealth. It is unfortunately (for the offender, but fortunately for the world) a part of the punishment of offences against honesty that the recollection remains long after the mischief may have been repaired. I cannot but recollect, however, the terms in which this particular offence was spoken of (see the *English Mechanic*, Vol. XX., p. 346) both in English and American papers, when as yet it was not known, and seemed likely to remain for ever unknown, who the offender might be. If there has been unfairness in this matter it has been in not directing against the offender, so soon as his identity was known, the condemnation which had been passed upon the anonymous writer,—even when it was supposed by many (naturally enough) that he was too far below contempt to be worth castigating.

IN a singular way a singular misprint occurs in the paragraph on the size of atoms on p. 76, 1st col. In converting into ordinary measures the metric relations which Prof. Thomson rather affectedly (considering he was addressing a popular audience) employed, I wrote that such and such numbers might *without serious error* be represented so and so. For the words italicised were substituted, in a paragraph for the *Newcastle Weekly Chronicle*, *without science even!* This was duly corrected in a proof received by me at Bournemouth, and the paragraph appeared correctly in the Newcastle paper. Unfortunately another proof was sent to me in town, and I cut out the paragraph from this uncorrected proof, forgetting that there was a serious error (without science even) in *that* "copy."

*** THE Editor has been prevented by ill-health, the result of recent railway collision, from completing for this week an instalment of his article on Sun-Spots, or his Answers to Correspondents. The articles on the Earth's Rotundity were, fortunately, completed before the accident. The lectures announced for the next fortnight will not be given, but he hopes to be able to give those announced for Tunbridge Wells and Hawkhurst.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

All Remittances, Cheques, and Post Office Orders should be made payable to MESSRS. WYMAN & SONS.

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

CHOLERA.

[892]—As an old Indian who passed through two of the worst visitations known in the North-West during this century, I can fully endorse the recommendation of Mr. Herring. The prescription he gives, or others very similar, proved most beneficial on these occasions; only they must be preceded by a purgative to remove the specific poison that is already at work in the system.

For this purpose was most extensively and successfully employed a pill containing 5 grains calomel, 1 grain rhubarb, ½ grain opium; to be made up with oil of cloves or oil of cinnamon. This was considered the dose for a woman or child, two being given to a man, and the pill should, if possible, be swallowed dry, without any liquid.

When the vomiting was too severe to allow even this pill to be kept down, it was found beneficial to administer in small quantities (say a dessert-spoonful) carbonate of soda (10 grains), or powdered magnesia (15 grains), dissolved in half-pint of filtered water—which seldom failed to allay both the vomiting and the distressing thirst.

It may be added that the patient should be kept warm with flannel wrapped round the body, and in extreme cases hot water bottles or hot bricks applied to the feet. J. W. B.

ANOTHER LARGE SUN-SPOT.

[893]—I hope you will not think I am troubling you too much about sun-spots in writing to say there is now another spot on the sun, so large as to be visible to the unaided eyes through smoked glass, I and several friends having seen it distinctly in that way on Saturday and yesterday (July 28 and 29).

It is a spot that has been on the sun's disc more than a week, and is now getting near the western edge, but I don't think it has been visible to the unaided eye before Saturday, as I looked for it several times before without success.

I am much obliged to "F.R.A.S." for the information he gives in No. 91 of KNOWLEDGE (Letter 880, page 60) about the tremendous area of the disturbance comprised in the fine group of spots visible to the unaided eye at the beginning of last month. The information does interest me very much. There is considerable difference between that case and the present one, for in that case the one spot, as it appeared to the unaided eye, was really, as viewed in the telescope, composed of several distinct spots very close together, the penumbra of each being distinctly separated from the others, whereas in the present case it is one entire spot as regards the penumbra, the only division being in the actual umbra, which is cut up into several very irregular-shaped parts, and I believe it is the gradual opening out, within the last day or two, of two or three of these previously separate parts of the umbra, and their consequent meeting or joining together, which has caused the spot to become visible to the unaided eye.

The observation of sun-spots is a subject in which I take very great interest, and devote every opportunity I have to it, and it is in the hope that my communications are of some little interest to you and some at least of the readers of KNOWLEDGE that I venture to trouble you with them so often. Of course, if you regard them at all otherwise I hope you will not hesitate to intimate as much, as I have no desire to be an unwelcome trespasser on either your valuable time or space. EXCELSIOR.

Huddersfield, *July* 30, 1883.

AMERICAN-ENGLISH.

[894]—I take the liberty of sending you a few notes on the subject of "British and American-English," suggested by your very interesting essay in "Leisure Readings," Vol. 1.

P. 185—*Abergavenny.* My family resided in this place for a great many years, and I never heard it spoken of under any other name than *Aberga'ny* until I went to school, where I had to use the former name to the exclusion of the latter.

P. 195—"*Mad.*" In Devonshire, as in America, the word is used to express *anger, crossness, ill-temper.* "Don't be so mad!" "He is as mad as he can be." In both cases meaning cross, out of temper. I remember hearing that, when a child was born in a certain family, the neighbours said, "Here is another mad G—— come," meaning that the child had possibly inherited the family temper, which was not very gentle.

P. 195—*Ordinary.* In Cambridgeshire and Suffolk I have often heard this word used to express inferiority, as in America. "An ordinary child" was "a plain child."

P. 199—*Reckon.* This word was formerly common in Sussex in the sense of "I believe," "I think," "It is probable, "He will go there to-morrow, I reckon."

P. 202—*Sure.* Formerly used in Sussex as it is now said to be used in America.

I am an old woman, in my 80th year, and have outlived most of these expressions, but I believe that they are genuine English, although provincial. MARY P. MERRIFIELD.

ERRATUM.

[895]—Your printer has made an omission in my description of the Magic Square in page 61 (888), which, in a manner, makes it unintelligible. It should run thus (fourth line from top of page): —"By the angles from the corners or the middles to the centre, whether right, acute, or obtuse; by the four corner, four middle and central cells; which will still hold good, &c." G. S.

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

By RICHARD A. PROCTOR.

PART XI.

IN Examples 12 and 13 we notice that, although the number of the triangles which can be constructed under the given conditions is infinite, yet all the triangles belong to a certain set, or family. In Ex. 12, the vertices of all the triangles on the base A B, lie on the circumference of the circle E F D. In Example 13 there is no curve along which the vertices are shown to lie; but if the reader were carefully to construct a number of triangles according to the method described in that example, he would find that the vertices all lie upon a certain curve, which however is not a circle.

These considerations introduce us to an important class of problems, called problems on *loci*.

If all points which satisfy certain relations can be shown to lie on a certain line (straight or curved), and if every point on this line satisfy the given relations, the line is called the *locus* (or place) of such points.

A few examples will serve better than a formal statement to show (1), the nature of *plane loci*; (2), the sort of problems founded on them; and (3), the methods available for readily solving such problems. It must be premised that the complete solution of such problems requires that it should be shown that both the conditions stated in the above definition of a locus should be fulfilled.

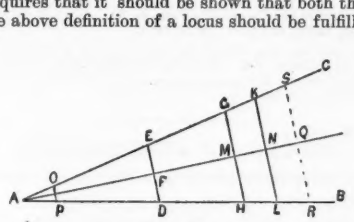


Fig. 25.

Ex. 16.—*The straight lines A B, A C (Fig.* 25) *intersect in A. From A equal parts A D and A E are cut off from A B, A C respectively. E D is bisected in F. Find the locus of all such points as F.*

Take A G equal to A H, A K equal to A L, and bisect G H in M, K L in N. Then it seems from the figure that the locus must be a straight line, whose direction is such as will carry it through A. A moment's consideration shows that the locus—whatever it be—must pass up to A; for if we conceive equal lines, A O, A P, very very small, the bisection of O P will be very very near to A. Again it will occur, from a consideration of the figure, that the locus is a straight line bisecting the angle A. Now, assuming for the moment that A F M N is such a line, we see that the triangles, A N L, A N K are equal in every respect (Euc. I., 4), and this leads us at once to the proof we require. For, because the base, K L, of the isosceles triangle A K L is bisected in N, therefore N lies on the bisector of the angle K A L. Similarly, every point obtained in accordance with the given conditions lies on the bisector of the angle K A L. It is clear, also, that every point in the bisector of the angle K A L fulfils the required conditions. For, let Q be such a point, and draw S Q R at right angles to A Q; then the triangles A Q S and A Q R are equal in every respect. (Euc. I., 26.) Therefore, A S is equal to A R, and S Q to S R; that is, Q is a point fulfilling the required conditions.

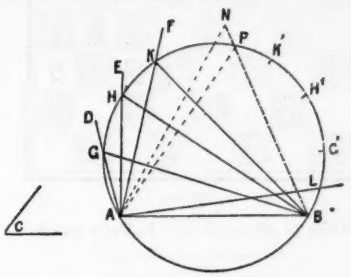


Fig. 26.

Points in the production of Q A beyond A cannot be said to fulfil the requisite conditions, because nothing has been said of the production of B A and C A beyond A.

Ex. 17.—*Determine the locus of the vertices of all the triangles which stand upon a given base, and have a given vertical angle.*

Let A B (Fig. 26) be the given base, C the given angle.

Draw from A straight lines, A D, A E, A F, and from B draw B G, B H, B K, to make, with A D, A E, A F, respectively, the angles B G A, B H A, and B K A equal to the angle C.*

We see at once that G, H, and K do not lie in a straight line, so that we gather that the locus is circular, since loci of other figures are not dealt with in deductions from Euclid.

Now we notice that we might have drawn our lines from B instead of A, and that therefore the locus must have points, G^1, H^1, K^1, situated in the same manner with respect to B as G, H, and K with respect to A.

It is already clear that a circle passing through, or near to A and B, contains all the vertices. We see also that the circle cannot but pass *through* A and B; for if we draw A L very very near to A B, then B L drawn so as to make the angle B L A equal to C, will clearly meet A L in a point very very near to B. We describe, then, a circle through A and B, and also (of course the circle is drawn by hand through the points G, H, K, &c.

At this point we cannot fail to be reminded of III., 21, which tells us that all the angles in the same segment of a circle are equal. We see, therefore, that our surmise is correct, and that the circular segment on A B, containing an angle equal to the angle C, is the locus we require. All the points on this segment fulfil the required condition; but points on the remaining segment, A M B, do not do so. If triangles are to be drawn on one side only of A B, the segment, A K B, contains *all* the required points. For if any point, N, without the segment fulfil the given condition, join N A and N B; let N B cut the segment, A K B, in P, and join A P. Then the angle, A N B, is equal to C (*hyp.*), but the angle A P B is equal to C (Euc. III., 21). Therefore, the angle, A P B, is equal to the angle A N B, the greater (Euc. I., 16) to the less, which is absurd. In like manner no point within the segment fulfils the required conditions. Therefore, the segment, A K B, is the required locus.

* There is no problem in Euclid which shows us how to do this, but of course there is no difficulty in the matter. Among the subsidiary problems mentioned in the first part, one should be given showing how to draw a straight line in the manner required. Here, however, we do not require the problem at all; since we are dealing with the practical construction of the figure—about which there is no difficulty—not with the mathematical treatment of the problem.

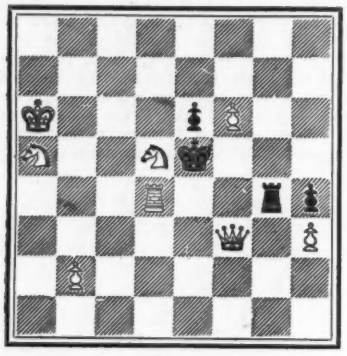
Our Chess Column.

By Mephisto.

PROBLEM No. 90.—SECOND PRIZE THREE-MOVER IN THE PROBLEM TOURNAMENT OF THE GERMAN CHESS ASSOCIATION.

By Herman Ascheboug, Christiania.

Black.



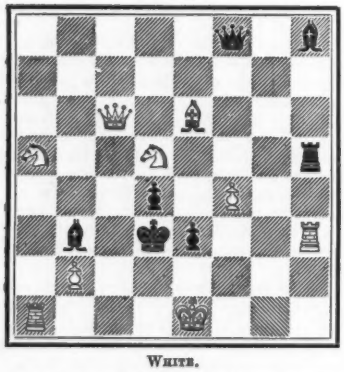
White.

White to play and mate in three moves.

PROBLEM No. 91.

By W. Terrill.

Black.



White.

White to play and mate in three moves.

SOLUTIONS.

Problem No. 88, p. 32.

1. Kt to K5	K takes Kt, or	1.	K to Kt4
2. Q to B sq	K moves	2. Q to B sq. (ch)	K takes P
3. Q mates accordingly.		3. Kt to B6 mate.	

Prize Problem No. 89, p. 64.

1. Q to R8.

1. R (R2) takes Q, or	1. R (Kt sq) takes Q
2. Kt to Q7 and mates accordingly	2. Kt takes KtP and mates acc.

or

1. Q takes R	1. R (Kt sq) to Kt2
2. Q takes R (ch) Any move	2. Kt to Q7 R takes Kt (best)
3. Q to R sq mate.	3. Q to K5 mate.

The other numerous variations of this beautiful problem are obvious.

*** Correction in the game on p. 80—White's fourth move should be B to Kt5.

Correspondents will kindly excuse omissions or delay in our answers on account of the late tournaments. We have made a terrestrial excursion in the Chess Domain; but we will again revert to our former habit of giving Chess for its own sake, and disclose to our readers the beauties and intellectual charms of our noble game, free of earthly dust.

As an exception to prove the rule of correctness, a mystifying error has occurred in our article on the tournament in our last number, p. 79, in the last paragraph. We meant to speak of Blackburne's "powerful" play, which somehow got converted into "powerless."

In the second tournament at Nuremberg, Herr S. Tarrasch, of Breslau, a young medical student, won the first prize. Messrs. Scheve, Lowenthal, and Neustadl tied for second, third, and fourth. Herr Rocamora, of Hamburg, won fifth, and Herr Bauer, sixth.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W.—Your solution of End game very interesting, but you will, no doubt, have seen by the solution published on p. 48 that the main variation is untenable on account of, firstly, advancing the P to R7; secondly, playing R to QR8; and thirdly, first checking on KB8 before playing R to KKt8, which allows the K to escape by Kt2, R3, Kt3, &c.

John.—In Problem 88, if 1. Kt to K5, K takes Kt. 2. Q to K7 (ch), K to B4. 3. Q to K6, K to Kt4, and there is no mate. 2. Q to B sq is correct; solution otherwise correct.

F. G. Richardson.—See above reply.

A. C. Gray.—We have had no special article on the subject, perhaps occasional references, such as in No. 73, p. 186; and No. 76, p. 228; or in No. 82, p. 313.

T. C.—Solutions incorrect; see p. 48.

Amateur.—We are sorry, almost ashamed, to say there is no suitable book on the openings in print. If you cannot get Cook's or Gossipp's, take Staunton or Wormold.

Stettin.—For solution of this fine Ending see p. 48.

Correct solutions received—Problems 86, 87, and 88 from Stettin. Problems 88 and 89 by W.

Problems received with thanks from W. Terrill, E. W. Smith, J. C. S.

Joseph Law.—Your diagnosis of the Prize Problem is not correct, as you may see by the solution published above. Fritz will therefore honour himself by cheerfully keeping the prize.

Contents of No. 92.

	PAGE		PAGE
A Naturalist's Year. Wasps and Flowers. By Grant Allen	65	Niagara. (*Illus.*) By R. A. Proctor	72
The Morality of Happiness: Conduct and Duty. By Thos. Foster	66	Laws of Brightness. VII.	74
The Chemistry of Cookery. XIV. By W. Mattieu Williams	67	Discovery of the Chief Division in Saturn's Ring. By Capt. Noble	75
Pretty Proof of the Earth's Rotundity. (*Illus.*). By R. A. Proctor	68	The Face of the Sky. By F.R.A.S.	77
How to Get Strong	70	Paradox Column: A New Theory of Copernicus	77
Pleasant Hours with the Microscope. (*Illus.*) By H. J. Slack	71	Correspondence	77
		Our Mathematical Column: Geometrical Problems. X.	78
		Our Chess Column	79

SPECIAL NOTICES.

Part XXI. (July, 1883), just ready, price 10d., post-free, 1s. 1d.

Volume III., comprising the numbers published from January to June, 1883, just ready, price 7s. 6d.

The Title Page and Index to Volume III. is now ready, price 2d., post-free, 2½d.

Binding Cases for Volume III., price 2s. each. Including carriage per Parcels Post to any address in the United Kingdom, 2s. 3d. Subscribers' numbers bound (including Title, Index, and Case) for 3s. each.

P. O. Orders and cheques should be made payable to the Publishers, Messrs. Wyman & Sons, London, at the High Holborn District Post-office.

Agent for America—C. S. Carter, American Literary Bureau, Tribune Buildings, New York, to whom subscriptions can be forwarded.

TERMS OF SUBSCRIPTION.

The terms of Annual Subscription to the weekly numbers of Knowledge are as follows:—

	s.	d.
To any address in the United Kingdom	10	10
To the Continent, Australia, New Zealand, South Africa & Canada	13	0
To the United States of America	$3.25. or 13	0
To the East Indies, China, &c. (*vid* Brindisi)	16	2

All subscriptions are payable in advance.

OFFICE : 74-76, GREAT QUEEN STREET, LONDON, W.C.